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Draft A

Interim Remedial Measures Proposed Plan for the 200-ZP-1 Operable Unit, Hanford Site, Washington

United States
Department of Energy
Richland, Washington

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INTERIM REMEDIAL MEASURES PROPOSED PLAN FOR THE 200-ZP-1 OPERABLE UNIT, HANFORD SITE, WASHINGTON

SEPTEMBER 1993

INTRODUCTION

The purpose of this *interim remedial measures** (IRM) proposed plan is to present, and to solicit public comments concerning the approach for conducting IRM activities for the 200-ZP-1 *Operable Unit* (OU) at the Hanford Site in Washington state. The 200-ZP-1 OU is one of two that encompass the groundwater beneath the 200 West Area of the Hanford Site. The other OU is the 200-UP-1 OU which is located just south of the 200-ZP-1 OU. The U.S. Department of Energy (DOE), as the lead agency, has recently completed a study of groundwater contamination beneath the 200 West Area. The report documenting this study, the 200 West Groundwater Aggregate Area Management Study (AAMS) Report, is available in the Administrative Record and provides detailed information concerning the 200-ZP-1 OU. The Administrative Record file, which contains all of the information used in the evaluation of the Hanford Site and cleanup alternatives, is available at the following locations:

U.S. Department of Energy
Richland Operations
Administrative Record Center
740 Stevens Center
Richland, Washington 99352

EPA Region 10
Superfund Record Center
1200 Sixth Avenue
Park Place Building, 7th Floor
Mail Stop: HW-074
Seattle, WA 98101

State of Washington Dept. of Ecology
Administrative Record
719 Sleater-Kinney Road SE
Capital Financial Building, Suite 200
Lacey, WA 98503-1138

The 200 West AAMS recommended that areas of groundwater containing the highest concentrations of three contaminants/plumes in the 200-ZP-1 OU — carbon tetrachloride, chloroform, and trichloroethylene (TCE) — be addressed under either an IRM or an *expedited response action (ERA)*. Discussions with the two regulatory agencies, the U.S. Environmental Protection Agency (EPA) and the Washington Department of Ecology (Ecology), have resulted in an agreement in principle to address all three contaminants/plumes under a single IRM.

The focus of this proposed IRM is the area of groundwater contaminated with a concentration of 1,000 ppb or higher of carbon tetrachloride. This area also includes some of the highest concentrations of

*Terms appearing in glossary are italicized in their first usage in the text.

trichloroethylene and chloroform. The aim of the IRM is to remove mass of these compounds from the aquifer system as early in the remediation process as possible. The groundwater contamination outside of the area addressed by this IRM would continue to be addressed by institutional controls (i.e., monitoring and groundwater use restrictions) until the development of the final remedy selection which will address all risks at this OU.

The IRM proposed here are consistent with the AAMS in that they will initiate interim actions to reduce the human health and environmental risks associated with carbon tetrachloride, chloroform, and trichloroethylene groundwater contamination. Consistent with the AAMS, this IRM proposed plan implements a bias for action rather than continued analysis.

The IRM activities proposed for 200-ZP-1 would consist of three main elements; (1) *pilot-scale testing*, (2) field characterization activities, and (3) full-scale interim remediation. Pilot-scale testing would evaluate and identify appropriate treatment systems for groundwater in the 200-ZP-1 OU. Field characterization would consist of activities (e.g., groundwater sampling and analyses, well construction, and in-situ testing) to provide information to support the interim remedial design. Interim remediation would consist of extracting and treating groundwater and possibly using other technologies (e.g., *in-situ sparging*). Information gathered during the interim remediation would be used to further refine IRM activities.

This IRM proposed plan fulfills the requirements of *CERCLA* Section 117(a) and will support the preparation of an *Interim Record of Decision (IROD)*. The IROD would be written and issued by the EPA and Ecology. The IROD would incorporate any changes to the selected IRM actions resulting from public comment on the IRM proposed plan.

In addition to presenting the preferred alternative (pages 6 through 10) this proposed plan also provides background on the project, including:

- a description of the location (page 3)
- a synopsis of studies conducted to date (page 3)
- a summary of risks to human health and the environment (page 7)
- a summary of all alternatives being considered, along with an evaluation of those alternatives (page 7)
- opportunities for public participation in selecting the IRM (page 2)
- a glossary that defines most of the acronyms and technical terms contained in this proposed plan (page 15)

HOW YOU CAN PARTICIPATE

You are encouraged to comment on this plan during the public comment period which will be held from ____ to ____. Written comments may be submitted anytime during the comment period. Please direct written comments or requests for more information to:

Dennis Faulk
U.S. Environmental Protection Agency
712 Swift Blvd., Suite 5
Richland, Washington 99352

or call (509) 376-8631 between 7:00 am and 4:30 pm Pacific Time, Monday through Friday, except holidays.

You are encouraged to attend an informational public meeting which will be held on --------- at the ------. Written and verbal comments will be accepted at the meeting.

The agencies will present their response to all comments received during the comment period in a *Responsiveness Summary*. After considering all comments, the DOE and EPA, in consultation with Ecology, will make a decision on the action for the 200-ZP-1 OU. This decision will become a part of the IROD for the site. The Responsiveness Summary is part of the IROD and will be available for public review at the Administrative Record locations listed above (page 1).

LOCATION AND HISTORY

The Hanford Site is located north and northwest of the confluence of the Yakima and Columbia Rivers in southeastern Washington state, and covers approximately 1,450 km^2 (560 mi^2). The Hanford Site was established in 1943 to produce plutonium for nuclear weapons using nuclear reactors and chemical processing plants. The Hanford Site is no longer a weapons production facility, and operations are now focused on environmental restoration.

The 200 West Area is an operational area of approximately 8.3 km^2 (3.2 mi^2) near the middle of the Hanford Site (Figure 1). Operations in the 200 West Area related mainly to processing *spent nuclear fuel*. Spent nuclear fuel was processed in four main areas of the 200 West Area: U Plant, where uranium recovery operations took place; Z Plant, where plutonium separation and recovery operations took place; and S and T Plants, where processing to separate uranium and plutonium from irradiated fuel rods took place.

The 200-ZP-1 OU is located in the 200 West Area and generally consists of contaminated groundwater and saturated soils beneath the Z Plant and T Plant areas. Although the 200-ZP-1 OU extends beyond the boundaries of the 200 West Area, the area addressed by this IRM proposed plan is within the 200 West Area boundaries (Figure 2).

Groundwater in the 200 West Area, as described in Section 3.0 of the AAMS Report, generally flows from west to east in an unconfined aquifer which lies about 200 feet below ground surface. In the vicinity of the 200-ZP-1 OU there is a groundwater mound which causes groundwater to flow to the north-northeast. The aquifer system is monitored on a regular basis under various environmental programs.

As stated earlier, this IRM addresses groundwater contaminated with the highest concentrations of carbon tetrachloride, trichloroethylene, and chloroform. The three chemicals are all chlorinated synthetic *volatile organic compounds* (VOCs) that tend to persist in the natural environment. Because of these similarities, they will respond similarly to methods to remove them from groundwater. The sources of these three contaminants are discussed briefly below.

Carbon tetrachloride was used in mixtures with other solvents to recover plutonium from waste streams. With repeated use, the carbon tetrachloride mixture lost its effectiveness and was discharged to waste management units in the 200-ZP-1 OU area. Waste containing an estimated total of nearly a thousand tons of carbon tetrachloride was discharged to the ground during the years 1949 through 1973. The maximum concentration of carbon tetrachloride now found in the groundwater in the 200-ZP-1 OU is approximately 7,000 ppb. This is approximately 1,400 times the *Maximum Contaminant Level (MCL)* of 5 ppb. The approximate extent of the carbon tetrachloride plume based on available

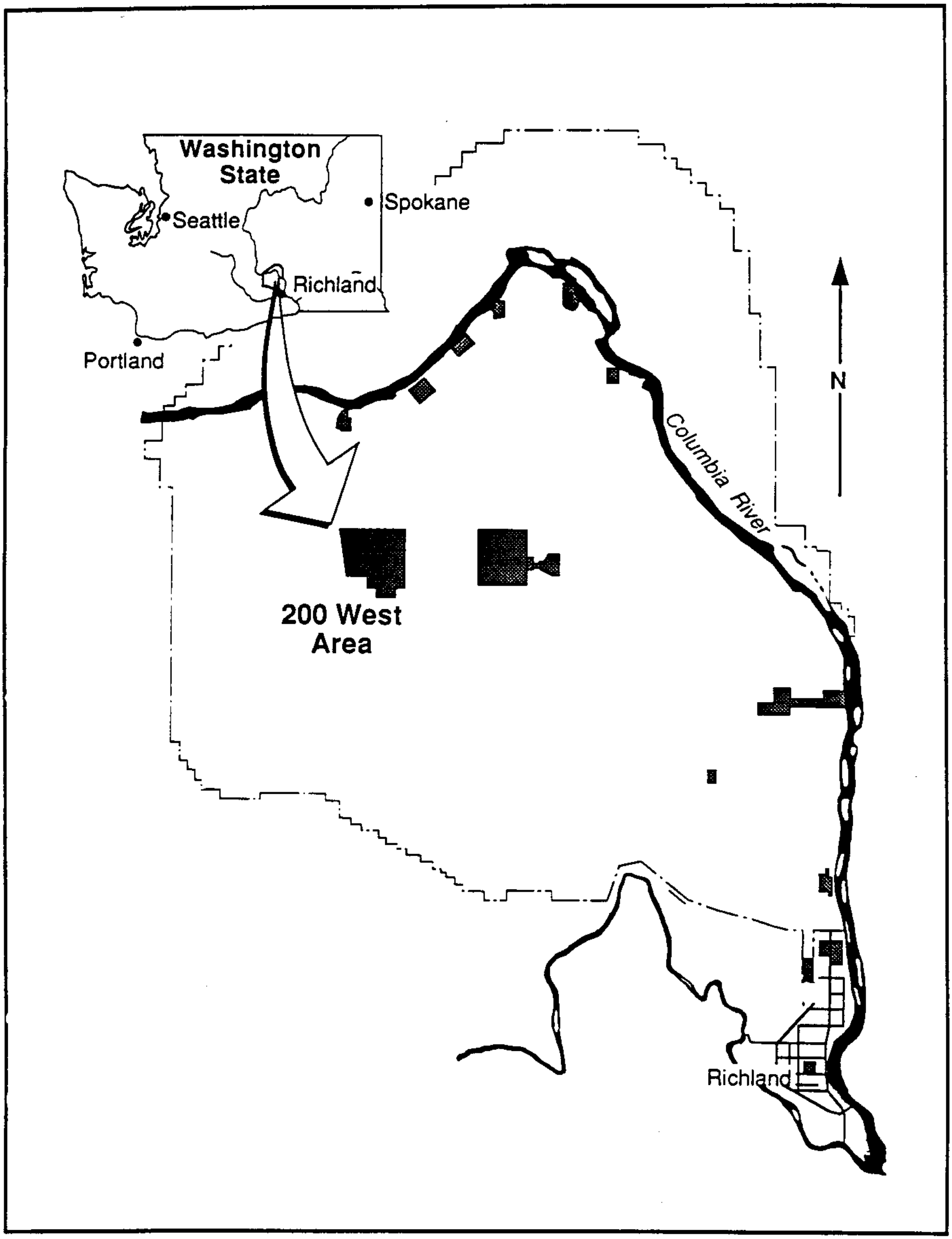

Figure 1. Location of Hanford Site and 200 West Area.

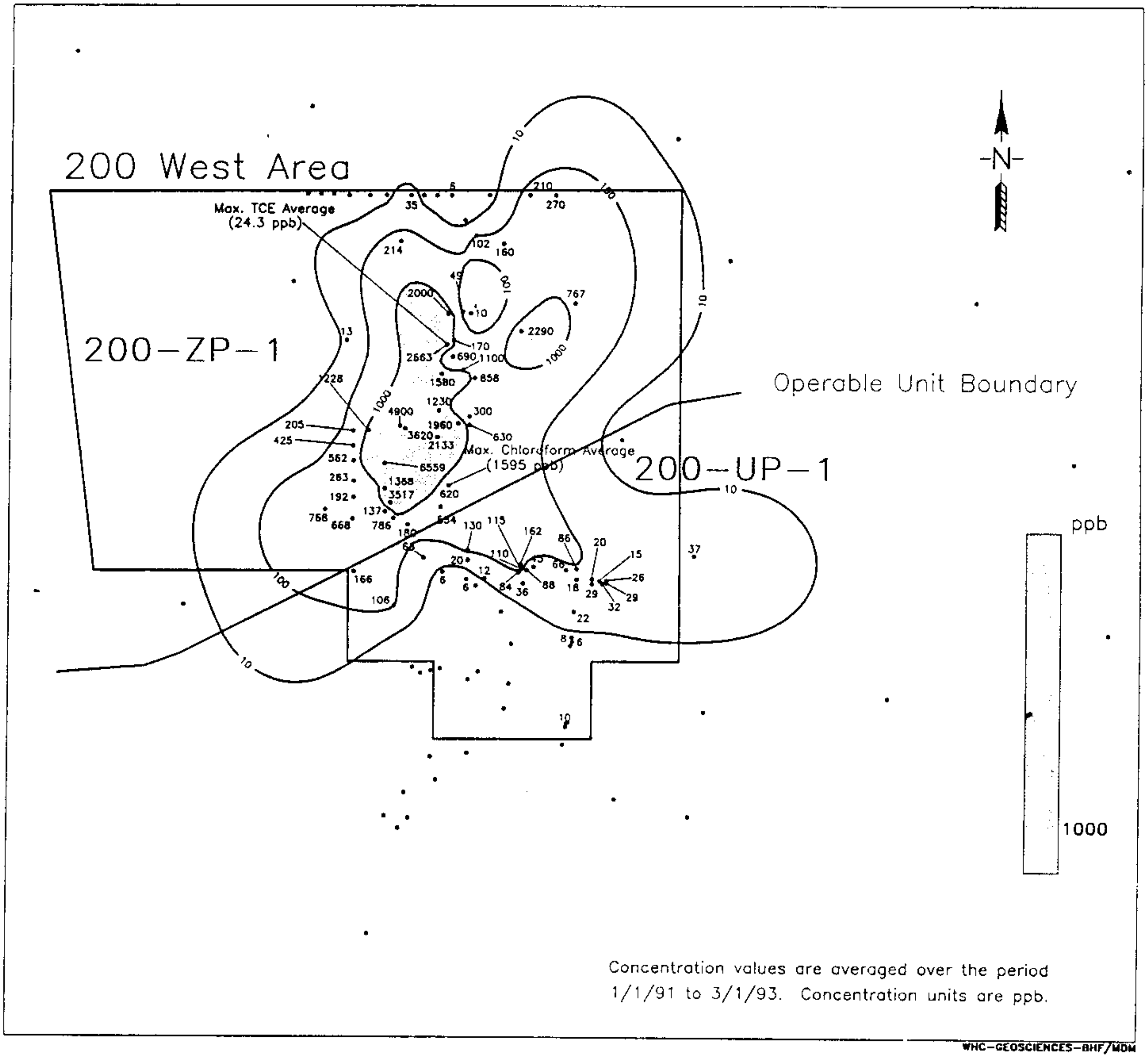

Figure 2. 200 West Carbon Tetrachloride Map.

information is shown in Figure 2. The carbon tetrachloride plume is the largest of the three plumes.

Trichloroethylene (TCE) was also discharged to waste management units. It does not appear to have been included as a chemical used in processing activities. However, TCE is commonly used as a cleaning and degreasing solvent. The extent of the TCE plume is smaller than the carbon tetrachloride plume. It is found in the groundwater at concentrations up to about 25 ppb (Figure 2).

The chloroform plume may be associated with the carbon tetrachloride plume since it is a common degradation product. Reportedly, chloroform was not used directly during processing activities in this area. Its highest concentration in groundwater is now observed to be about 1,600 ppb (Figure 2).

ACTIVITIES LEADING TO THESE INTERIM REMEDIAL MEASURES

The IRM activities in this IRM proposed plan are based primarily on information from the AAMS and the 200 West Area Carbon Tetrachloride Expedited Response Action (ERA). These two programs have provided sufficient information to begin IRM activities. Additional information gained during pilot-scale testing and characterization activities will be used for remedial design.

The AAMS compiled and evaluated what is known about the groundwater beneath the 200 West Area. The information provided in the AAMS Report consists of detailed information regarding contaminant sources, background information, physical setting, known and suspected contamination, and the possible pathways that would allow exposure to contaminants.

Based on known information and some additional field work, the AAMS provided recommendations for groundwater contaminants/plumes to be addressed under one of four paths. The four paths are ERAs, IRMs, *Limited Field Investigations (LFIs)*, and *Final Remedy Selection (FRS)*. Of these four paths, the first two are meant to accelerate cleanup through the use of interim measures where enough information is known to allow activities to begin. Addressing these areas quickly also limits the potential spread of contamination.

The AAMS Report provides most of the information typically included in a Remedial Investigation/Feasibility Study (RI/FS), with the exception of treatability testing and a *baseline risk assessment*. Treatability testing, often performed at other sites prior to the final feasibility study, would be performed as the pilot-scale testing described in this IRM proposed plan. Although a baseline risk assessment has not yet been performed, a *qualitative risk assessment* was performed as part of the AAMS

An ongoing 200 West Area Carbon Tetrachloride Expedited Response Action is an ERA removing carbon tetrachloride from the *vadose zone* in the 200 West Area. The 200 West Area Carbon Tetrachloride Expedited Response Action has provided additional information on the distribution of carbon tetrachloride in the soil above the groundwater in the 200-ZP-1 OU. Because carbon tetrachloride in the vadose zone may be a source for groundwater contamination, information concerning its distribution is helpful to this effort and will be considered. The information from this ERA will be used to help locate characterization and extraction wells.

SCOPE AND ROLE OF RESPONSE ACTION

This response action addresses contaminated groundwater found at the 200-ZP-1 OU. The principal risks identified at the 200-ZP-1 OU are from carbon tetrachloride. Lesser risks are posed by trichloroethylene and chloroform in groundwater. The role of the activities presented here is to reduce the potential risk posed by these compounds to human health and the environment. This is accomplished by focusing activities on areas in the 200-ZP-1 OU with the highest concentrations of these compounds. Because carbon tetrachloride poses the greatest risk, preference would be given to areas of high (above 1,000 ppb) carbon tetrachloride concentration. This generally coincides with the highest levels of trichloroethylene and chloroform contamination.

As discussed in the AAMS Report, the information obtained from IRM activities, along with information from other activities in the 200 West Area such as the LFI activities in the 200-UP-1 OU just to the south, would be used to identify the final remedy selection for the 200-ZP-1 OU. The process of final remedy selection must be completed for the 200 West Groundwater Aggregate Area, and the 200-ZP-1 OU, to reach closure.

Summary of Site Risks

A qualitative assessment of potential impacts to human health and environment was performed as part of the AAMS and is discussed in Sections 4.0 and 5.0 of the AAMS Report. The assessment includes a discussion of potential transport pathways, develops a conceptual model of human exposure based on these pathways, and presents the physical, radiological, and toxicological characteristics of the known or suspected contaminants.

The primary transport pathway addressed in the assessment is migration of contaminants from waste management units and unplanned releases to groundwater, transport within groundwater, and transport from groundwater to surface water.

Contaminants of potential concern used in the qualitative risk assessment were identified for the entire 200 West Groundwater Aggregate Area (i.e., both 200-UP-1 and 200-ZP-1 OUs). The AAMS found that the maximum observed concentration of carbon tetrachloride in the groundwater posed the highest carcinogenic risk, relative to other groundwater contaminants, in the 200 West Area. This IRM was thus designed to reduce this highest risk as quickly as possible.

Summary of Evaluation of Alternatives

A screening of remedial technologies was performed as part of the AAMS. The screening process first identified a preliminary remedial action objective and then identified general response actions to meet that objective. General response actions represent broad classes of remedial measures (e.g., pump-and-treat). General treatment, resource recovery, and containment technologies applicable to each general response action were also identified. Specific process options belonging to each technology were identified, and these process options were subsequently screened based on their effectiveness, implementability, and relative cost. Actual costs for various options were not calculated because the treatability testing necessary to generate these numbers has not yet been performed. A rough relative cost scale of high, medium, and low was used in the screening.

In addition, the AAMS recommended that either of two technologies be used to rapidly address the carbon tetrachloride, chloroform, and trichloroethylene contaminated groundwater. These two technologies are in-situ sparging and pump-and-treat.

An evaluation of treatment alternatives specific to the 200-ZP-1 OU follows.

Treatment Alternatives

Four potentially suitable alternatives were evaluated for remediation of the contaminated groundwater within the 200-ZP-1 OU. These alternatives are:

Alternative 1. No action, in which the contaminants are allowed to migrate, dissipate, and naturally decompose over time.

Alternative 2. Physical barriers that would restrict the flow of contaminated groundwater; such barriers could include a slurry-wall (a mud-filled trench that extends deep into the ground), hydraulic barriers (injecting clean water around the contaminated water to form a wall of clean water), and freeze barriers (freezing the groundwater to form an ice wall)

Alternative 3. In-situ (or in-well) sparging, consists of a downhole air stripper in a well which removes VOCs from groundwater. Air is bubbled through the well to vaporize the contaminants. The stripped vapors are then removed from the well with a vacuum extraction system.

Alternative 4. Extraction and treatment of the groundwater (referred to as "pump-and-treat"); the water is pumped out and treated using one of a number of possible water treatment systems located above ground. The treated water would then be discharged back to the aquifer.

Evaluation Against the Seven Criteria

The alternatives available for treating the groundwater contamination at 200-ZP-1 must be evaluated according to seven criteria:

1. Overall protection of human health and the environment
2. Compliance with applicable or relevant and appropriate requirements (ARARs)
3. Long term effectiveness and performance
4. Reduction of toxicity, mobility, or volume through treatment
5. Short-term effectiveness
6. Implementability
7. Cost

Two additional criteria are also used: state and community acceptance. These criteria will not be addressed until the state and the public review the proposed plan. Community acceptance will be determined in the responsiveness summary that will be developed as a result of public comments on this proposed plan.

The 200-ZP-1 IRM is intended to reduce existing risks with the knowledge that final remedy selection is planned for a later date. Therefore, the application of these criteria necessarily focuses on near-term issues with consideration of long-term clean-up plans. For example, compliance with ARARs may receive less emphasis at this point because of the need to address the higher risk issues first. The longer-term cleanup plan would address ARARs in detail.

A summary table showing these seven criteria applied to the four alternatives is presented as Table 1. A brief discussion of the highlights of the evaluation is presented here.

OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT: The no action alternative does not change the overall protection of human health and the environment, whereas the in-situ sparging and pump-and-treat actually treat the contaminants. The physical barriers alternative slows the migration of contami-

Because this action is an Interim Remedial Action, it is designed to reduce risk through mass reduction, not to specifically meet ARARs. Potential ARARs were identified in the AAMS Report, but no final identification of ARARs has yet been made. The final remedy selection path will address ARARs for the 200-ZP-1 OU.

Description of Proposed Activities

The proposed IRM activities for the 200-ZP-1 OU are briefly described in the following sections. It is believed that these actions would achieve the remedial action objective of reducing risk to the environment and human users of the area. The stages of the IRM include pilot-scale testing, supporting field investigations, remedial design or optimization, and full-scale remediation.

Pilot-Scale Testing

Before a remediation system can operate at full scale it is necessary to test the method on-site by operating it on a smaller size, called pilot scale. Pilot-scale testing would assess the effectiveness of the technology(ies) for removing the IRM contaminants from groundwater under field conditions. In addition, the effectiveness of the treatment system on other compounds occurring with the IRM contaminants would also be examined.

The overall objective of the pilot-scale testing is to demonstrate the operational effectiveness of selected treatment technologies for the groundwater at the 200-ZP-1 OU. The pump-and-treat and in-situ sparging systems to be tested are of sufficient size that reasonable cost information would be acquired with which to determine cost-effectiveness. The operational effectiveness of these selected treatment technologies and aquifer response will also be evaluated. Included in the operational effectiveness is demonstrating the capability of combined technologies for removing most of the contaminant mass at a particular site. As a result, an attempt would be made to measure the general degree of cleanup achieved by monitoring the change in plume concentrations over time.

The more detailed specific objectives of the pilot-scale testing of both pump-and-treat and in-situ sparging are the following:

- Demonstrate the stability of the selected treatment system under steady-state operation;
- Compare the effectiveness of processes for reliability and efficiency;
- Determine the appropriate order of unit processes for treating VOCs which are potentially mixed with a wide variety of other contaminants;
- Monitor electrical power costs, chemical costs, maintenance performed, and on-line efficiencies, and estimate reasonable personnel requirements for operating each system based on operating experience gained during the tests;
- Determine the benefits derived from making the systems less manual, that is, whether increasing automation of operations would be of benefit (the systems currently require "hands-on" operation);
- Investigate/evaluate methods for disposing of the secondary wastes generated (e.g., solids and resins) during the operation of the systems;
- Establish a monitoring/sampling plan for determining the rate of removal of contaminants from the groundwater; and

- Determine the effects of varying system parameters such as flow, concentrations or amount of chemicals, mixing rates and residence times.

As part of the pilot-scale testing of the pump-and-treat system, several different potential treatment methods will be evaluated. These include activated carbon adsorption and UV-oxidation.

Activated Carbon Adsorption. The use of activated carbon for removal of dissolved organics, such as carbon tetrachloride, chloroform, and trichloroethylene, from water and wastewater has been demonstrated to be highly effective. Activated carbon removes organics by the process of adsorption, the attraction and accumulation of one substance on the surface of another. Activated carbon adsorption would be the primary organic removal technology demonstrated in the treatability tests described herein.

Activated carbon can be prepared from a wide variety of carbonaceous materials and comes in various forms. An activated carbon with high affinity for the groundwater contaminants will be selected.

Activated carbon for water or wastewater treatment may be either powdered or granular in form. Powdered activated carbon is generally injected into a pipeline, or added to a tank, where it is intimately mixed with the waste to provide the desired organic removal. The carbon is then allowed to settle, and either disposed or regenerated for recycle/reuse. Granular-activated carbon, on the other hand, is placed in a vessel with screens to retain the granular-activated carbon. Water or wastewater is then passed through the vessel for organic removal.

A potential problem with this system is the generation of *mixed waste*, a mixture of hazardous and radioactive wastes, as a by-product. The difficulty and expense of disposing of such material will have to be evaluated during the pilot scale testing.

UV-Oxidation. Organic contaminants can be effectively destroyed in water using a technology known as ultraviolet-enhanced oxidation or UV-oxidation. With this technology, oxidants such as hydrogen peroxide or ozone are added to a water stream which is then exposed to intense ultraviolet light from a bank of special lamps. The UV light activates the hydrogen peroxide to create hydroxyl radicals which act as extremely powerful oxidizing agents on the organic molecules present in the water. The oxidation of the organics by these oxidizing agents ultimately produces carbon dioxide or other innocuous products. The method is unaffected by radioactive contaminants.

The major drawbacks to UV-oxidation are its high energy demands, significant operation and maintenance requirements, the complexity of the equipment, and the high initial capital costs for the installation.

Effects of Other Contaminants on Treatment Systems. As well as the carbon tetrachloride, chloroform, and trichloroethylene to be addressed by activated carbon adsorption and UV-oxidation discussed above, other contaminants may be present in the groundwater. The other contaminants present in the groundwater vary depending upon the location chosen for the pilot-scale testing. As noted above, although the pilot-scale testing will focus on the IRM contaminants, it would also assess the systems' ability to treat these other contaminants. In some cases the other contaminants may be radioactive, and could lead to generation of mixed wastes which may be difficult to dispose of.

IBM Supporting Field Investigations

The decision to carry out an IRM is based on existing data about the distribution of carbon tetrachloride, chloroform, and trichloroethylene in the groundwater and soils. The

Table 1. Evaluation of 200-ZP-1 Alternatives

	Alternative 1: No Action	**Alternative 2: Physical Barrier**	**Alternative 3: In-situ Sparging**	**Alternative 4: Pump and Treat**
Criterion				
Overall protection of human health and the environment	No additional protection	Reduced migration reduces potential exposure	Contaminants removed through treatment	Contaminants removed through treatment
Compliance with ARARs	No reduction of contaminant mass	Reduces migration but does not reduce contaminant mass	Reduces contaminant mass	Reduces contaminant mass
Long term effectiveness and performance	No reduction of contaminant mass	Reduces but does not prevent plume migration. No reduction of contaminant mass	Reduces contamination through treatment	Reduces contamination through extraction and treatment
Reduction of toxicity, mobility, or volume through treatment	No reduction through treatment	No reduction through treatment	Contaminants reduced by vapor phase treatment	Contaminants reduced by water phase treatment
Short-term effectiveness	No change	Reduces migration of plume	Treats zone of greatest contamination	Treats zone of greatest contamination
Implementability	No action required	Difficulties with installing and maintaining at large depth	In late stages of development	Can implement using existing technology
Cost	None	High	Moderate	Moderate to high

nants, but does not actively treat them.

COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS): None of the alternatives treats the groundwater contaminants to potentially applicable water quality standards, but the in-situ sparging and pump-and-treat alternatives will reduce the mass of contaminants found in the groundwater.

LONG TERM EFFECTIVENESS AND PERFORMANCE: The no action alternative provides no long term effectiveness and performance. Physical barriers reduce the migration of contaminants, but do not provide significant reduction of contamination. The in-situ sparging and pump-and-treat alternatives provide the best long-term effectiveness by actually treating the contaminants.

REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT: The no action alternative provides no reduction of toxicity, mobility, or volume through treatment. Alternative 2, physical barriers, offers no treatment but reduces mobility. In-situ sparging and pump-and-treat alternatives provide treatment, thereby reducing the volume of contaminants that may potentially migrate.

SHORT-TERM EFFECTIVENESS: The no action alternative has no short-term effect on the contamination. The remaining alternatives offer short term effectiveness by limiting the migration of the contamination (Alternative 2) or by reducing the most significant contamination in the areas of highest concentration (Alternatives 3 and 4).

IMPLEMENTABILITY: The no-action alternative is easily implemented, because no changes are made to the site. The physical barriers alternative may difficult to implement because the depth to groundwater is large (about 200 feet). Integrity of the barrier would be difficult to maintain at this depth. In-situ sparging is still in the later stages of development, so its implementability is not fully established. Pump and treat may be implemented using available technology.

COST: Cost estimates cannot be provided at this stage of remediation because of uncertainties in the extent of contamination and other site and technology details. Relative cost estimates will be considered instead. The no-action alternative has essentially no added cost. Physical barriers are judged to be high in cost because of the need to construct deep barriers over a long distance. In-situ sparging is considered to be moderate in cost; the major cost components include wells, aeration equipment, and a vapor treatment system. The pump-and-treat alternative is considered moderate to high cost, and includes wells, pumps, and a more sophisticated treatment system.

PREFERRED ALTERNATIVE

The preferred alternative for the IRM activities is a combination of pump-and-treat with limited implementation of in-situ sparging (in-well sparging) to develop this innovative, and potentially less costly, remedial technology. The two technologies are readily available and should be effective together at reducing the mass of carbon tetrachloride, trichloroethylene, and chloroform in groundwater.

This alternative is protective of human health and the environment. The preferred alternative is intended to reduce risk to human health and the environment by reducing the mass of contaminants in the groundwater and helping to control future spreading of these contaminants. This alternative addresses the transport pathway addressed in the AAMS Report assessment by addressing transport within groundwater.

quality and quantity of these data are considered sufficient to make a decision of this nature. However, there are a number of data needs to be addressed to optimize the final remedial design and support a baseline risk assessment through field investigation work. These issues include:

- nature and extent, both vertical and horizontal, of the contaminants
- the hydrogeology
- aquifer properties for design of the extraction and aquifer disposal system
- the presence of other chemicals and the chemical characteristics of the aquifer.

These data needs are not sufficient to change the decision to initiate an IRM because the IRM can be effective at removing measurable quantities of contamination. Resolving these issues can improve the efficiency of the remedial design, can guide further remedial action beyond the extent of the present IRM, and may address wider issues associated with the site groundwater. In addition, completing the baseline risk assessment will help identify remediation goals for this IRM, and future activities.

The data needs outlined above are best satisfied by field investigation. In many cases these investigations may be accomplished during the installation of wells for the IRM. However, some of the data needs require installation and sampling of new monitoring wells at locations where no previous investigations have placed wells, to address data needs such as the extent of contamination, or to sample appropriate wells and to analyze the site geochemistry. Such field investigation activities are carried out continuously at the Hanford Site for various reasons, and many of the questions that should be addressed for the IRM will be included as part of these on-going studies.

Additionally, data needs which will also be addressed by this IRM proposed plan pertain to the nature of the carbon tetrachloride occurrences which may include separate phases (e.g., *DNAPLs*, dissolved).

Carbon tetrachloride, for example, is soluble only to a limited extent in groundwater. If more than this quantity of carbon tetrachloride is present, it can form "pools" or "droplets" of pure carbon tetrachloride, known as DNAPL. If carbon tetrachloride is disposed to the ground in large enough quantities, this combination of properties allows it to flow down through the soil, and even through the groundwater because it is heavier than water. If there is a low permeability layer in the soil or aquifer, pools of undissolved carbon tetrachloride can accumulate. If there is a slope on this low permeability layer, the undissolved carbon tetrachloride can flow along its surface regardless of the groundwater flow direction, and possibly form pools at low points.

If undissolved pools or droplets of carbon tetrachloride do exist at the 200-ZP-1, they could prolong aquifer remediation if they are not removed or isolated. Undissolved carbon tetrachloride can contribute dissolved contamination over decades to passing groundwater. Although these occurrences are difficult to locate and have not been observed in the groundwater in the 200-ZP-1 OU to date, the IRM field investigation will attempt to assess the potential for such occurrences. If undissolved carbon tetrachloride is present it will be difficult to clean-up the groundwater thoroughly. In addition, experience at other locations has shown that contaminant concentrations can return to before-remediation, or higher, levels after the pump-and-treat is terminated.

Remedial Design/Optimization Stage

During the remedial design stage, information gained from field activities and from the pilot-scale testing would be used to optimize the design of the pump-and-treat system. This would involve evaluating the results of the pilot-scale testing to identify the specific treatment system to be used and the wells to be used for extraction and disposal of treated groundwater and optimum operation rate, well design and placement. Completion of testing will depend on having sufficient information to begin full-scale remediation and the attainment of an adequate removal efficiency of the process, such as a 90% removal of each of the VOC contaminants of concern.

Although a specific treatment system could be identified at this time, enough flexibility should be retained to modify the treatment system to address unforeseen problems and/or changing groundwater conditions. Additional treatment systems may be identified at this stage for specific locations within the 200-ZP-1 OU. Also, addition of in-situ sparging systems, or other treatment technologies which have been evaluated or tested under other programs, may be combined with the pump-and-treat system at this time.

Full-Scale Remediation Stage

The pump-and-treat system used for the pilot-scale testing would transition from pilot-scale testing to full-scale interim remediation (actual implementation of the IRM). The dividing line between these two activities may not be well defined as remediation of groundwater would also occur during the pilot-scale testing and modifications may continue to be made after full-scale implementation.

Since the primary goal of the pilot-scale testing is to determine design, construction, and operation parameters of a treatment system, a phased-in approach would be used in transitioning into and continuation of full-scale interim remediation. Two criteria must be met in order for the pilot scale pump-and-treat system to transition to full-scale interim remediation: (1) At the conclusion of the pilot-scale testing, the treatment system must be able to demonstrate a minimum of 90 % removal of the carbon tetrachloride, chloroform, and trichloroethylene from the extracted groundwater, and (2) the system must be able to extract from groundwater 140 grams (0.3 lbs) of carbon tetrachloride per day. This second criteria is based on pilot-scale operations which would involve a six to seven hour processing day, processing 100 gallons of water per minute with a concentration of 1,000 ppb carbon tetrachloride and a 90 percent removal efficiency. Due to the relatively small pumping rates and limited time-frame of the pilot-scale testing, no criteria for demonstrating an effect on contaminant concentrations in the groundwater is proposed until the full-scale remediation stage. During the course of the full-scale operations, the decision points and stricter performance criteria for continuation of the IRM, will be negotiated with the regulatory agencies.

The IRM is designed to allow modification to the treatment system as new information is gained. Additional treatment systems may be established at other locations within the 200-ZP-1 OU, and pump-and-treat systems may be moved to other locations within the 200-ZP-1 OU as groundwater flow patterns or contaminant concentrations change. In addition, in-situ sparging wells may be added as information is gained concerning this technology.

Schedule

ISSUE IROD	1/28/94
BEGIN PILOT SCALE TESTING	2/28/94
BEGIN REMEDIATION STAGE	10/1/94

Future Activities

The IRM activities proposed in this IRM proposed plan are intended to address the highest risks identified in the 200-ZP-1 OU.

The purpose of these activities is to reduce risk to human health and the environment by reducing the mass of contaminants in the groundwater. The IRM would continue until the remediation goal of reducing carbon tetrachloride concentrations below 1,000 ppb is met or until the system becomes ineffective: contaminant concentrations no longer diminish or natural attenuation exceeds active treatment. At this point the IRM would be discontinued and any additional remediation would be addressed under the final remedy selection path. The technology chosen in the final remedy selection may be different than the technology chosen for the IRM activities.

Glossary

Baseline Risk Assessment. The detailed estimation of possible risk to human health or the environment due to hazardous or radioactive wastes at a site. Risk assessment methods can produce numerical scores of risk which allow comparison with other kinds of risk.

Comprehensive Response, Compensation, and Liability Act (CERCLA). The "Superfund" law which describes how the nation's most contaminated sites are to be cleaned up.

Dense Non-aqueous Phase Liquids (DNAPLs). Liquids which are only slightly soluble in water, and so form a separate phase (like oil on water), but are heavier than water.

Expedited Response Actions (ERA). A path of action where an existing or near-term unacceptable health or environmental risk from a site is determined or suspected, and a rapid response is necessary to mitigate the problem.

Final Remedy Selection (FRS). The final remedy selection is the path of action to determine the final remedy for the 200-ZP-1 Operable Unit. This path includes the preparation of the Remedial Investigation/Feasibility Study, Proposed Plan, and Final ROD.

In-Well Sparging. A water treatment method in which sparging air is pumped into a well and released into groundwater. As the air expands and rises through the groundwater, small bubbles extract and transport volatile chemicals upward. Once the bubbles reach the air in the well, vacuum extraction would remove the air. The air would then be treated and either discharged or recycled for additional extraction cycles.

Interim Record of Decision (IROD). Document describing the selection of an interim remedial action under CERCLA by technically describing the remedy and providing a consolidated source of information about the site and the selected remedy. Contains the Responsiveness Summary.

Interim Remedial Measures (IRM). An on-site response initiated at any time prior to the initiation of the final remedial action.

Limited Field Investigations (LFI). An investigation to obtain minimum site data needed to support a decision as to whether to perform an IRM. Less formal than an investigation needed to support a final Record of Decision (ROD).

Maximum Contaminant Level (MCL). The maximum concentration of a particular contaminant allowable in drinking water.

Mixed Waste. A mixture of hazardous and radioactive waste.

Operable Unit (OU). Related geographical areas of contamination at Hanford have been grouped into separate Operable Units, allowing them to be prioritized and remediation efforts to be focussed. The

200-ZP-1 OU is one of two groundwater Operable Units in the 200 West Area of the Hanford Site.

Parts per Billion (ppb). The concentration level of one pound of contaminant in one billion pounds of water, about half a foot over a square mile.

Pilot-Scale Testing. Testing of an engineering system at a small but in-field size to evaluate possible limitations on its ultimate full-scale implementation.

Qualitative Risk Assessment. A less precise methodology of comparing risks than the baseline risk assessment.

Responsiveness Summary. The part of the IROD which summarizes significant comments received from the public and provides the agencies an opportunity to comment "on the record."

Spent Nuclear Fuel. Spent nuclear fuel is fuel that has been withdrawn from a nuclear reactor following irradiation.

Treatment Systems. A combination of various treatment equipment for cleaning-up extracted groundwater. This may involve some combination of a wide variety of physical, chemical, or other techniques.

Vadose Zone. The layers of unsaturated soil which are above the water table.

Volatile Organic Compounds (VOCs). Chemicals based on carbon which readily evaporate (volatilize). This family includes many commonly used solvents.

Waste Management Units (WMUs). An individual location where wastes were placed such as trenches, ponds, or cribs.